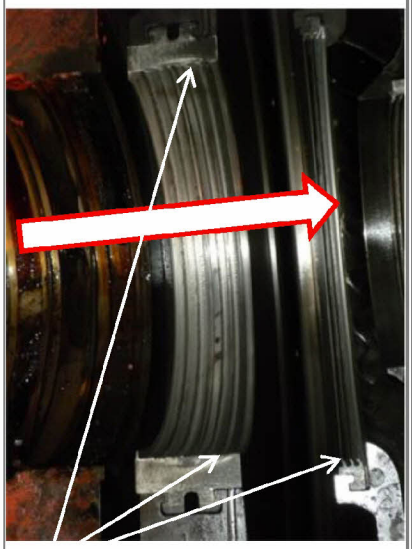
Richmond LPS Bulletin –Reliability

K-300B Compressor Rotor Failure (2/13/2011)

IMPACT ERM:
Loss# 10605 Inv# 7248

Location:
Hydroprocessing, Rotating Equip Reliability (RER)

Contact Information:
Cort Johnsen (RER)
510-242-4328
cwjo@chevron.com



Damaged internal balance piston labyrinths

Tenets of Operations Violated:

#1-Always operate within design and environmental limits
#3-Always ensure safety devices are in place and functioning

IIF -- Every Task, The Right Way, Every Time

Incident Description:

On the night shift on 2/13/2011, the K-300B compressor developed a noise emanating from the gearbox. RER monitored it but could not confirm excessive rotor thrust movement. On 2/16/2011, it was shut down to investigate the gearbox noise. RER found excessive movement of the rotor shaft due to a thrust bearing failure, which caused the impellers and diaphragms to rub and become damaged.
K-300B was out of service for eleven weeks until 5/5/2011 while a new case and spare rotor were procured from a salvage yard, quickly reconditioned, and installed to restore the normal rate of hydrogen production. The cumulative lost production over 3 months was $1.9 million plus the direct repair expense of $500,000.

Investigation Findings:

1) The K-300B thrust bearing and balance piston labyrinths, which maintain rotor axial position, had failed. This allowed the rotor to drift axially until the impellers damaged the diaphragms.
2) The rotor thrust load exceeded the capacity of the thrust bearing and could no longer be sustained due to decreased oil film thickness at the thrust pads.
3) The thrust pads and interlocking balance piston labyrinths were partially degraded from accumulated damage from prior startups involving progressive surge cycles. Each of these cycles resulted in axial rotor movement in excess of the thrust bearing clearances.
4) Lack of a good process control and monitoring system contributed to damage of the thrust bearing being undetected prior to this failure.

Lessons Learned:

1) The noise from the gearbox was only a symptom of the thrust bearing failure. Continuous vibration monitoring and thrust position instrumentation are valuable for timely diagnosis and failure prevention of critical un-spared machinery.

Recommendations:

1) Implement a control system and operational improvements such as a dedicated surge avoidance procedure and system for both K-300 machines.
2) Install Bently vibration probes to monitor and protect the K-300's.
3) Rebalance the hydraulic axial load on the K-300A from thrust bearing to balance piston.
4) Determine whether installing instruments to continuously measure the pressure and flow from the balance piston cavity to the suction is feasible.